The 13th ICFA Beam Dynamics Mini-Workshop

Beam Induced Pressure Rise in Rings

Brookhaven National Laboratory, Upton, NY

December 9 - 12, 2003

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13th ICFA Beam Dynamics Mini-Workshop
Workshop of Beam Induced Pressure Rise in Rings
Program

Monday, December 8, 2003

Berkner Hall, Lobby

19:00 – 20:30 Reception and Registration

Tuesday, December 9, 2003

Medical Building LCR (Large Conference Room), Building 490

Morning Session - Chair: Miguel Furman

09:00 – 09:10	Welcome	Tom Kirk	BNL Assoc. Director
09:10 – 09:40	RHIC Status and Plans	Thomas Roser	BNL
09:40 – 10:20	Electron Cloud Effects and LHC Concerns	Francesco Ruggiero	CERN
10:20 – 10:40	Coffee Break		
10:40 – 11:20	Beam Loss and Electron Cloud in the SNS Ring: Issues and Remedies	Jie Wei	BNL
11:20 – 12:00	Beam Induced Pressure Rise in RHIC	Wolfram Fischer	BNL
12:00 – 13:30	Lunch		

Afternoon Session - Chair: Katherine Harkay

13:30 – 14:10	HIF (Heavy Ion Fusion) Concerns	Arthur Molvik	LLNL
14:10 – 14:50	The International Accelerator Project at GSI	Oliver Boine-Frankenheim	GSI
14:50 – 15:30	LEIR: The Low Energy Ion Ring at CERN	Michel Chanel	CERN
15:30 – 15:50	Coffee Break		
15:50 – 16:30	Electron Cloud Induced Pressure Rises in the SPS	Jose Miguel Jimenez	CERN
16:30 – 17:10	AGS Booster Issues	SY Zhang	BNL

Wednesday, December 10, 2003

Medical Building LCR, Building 490

Morning Session - Chair: Francesco Ruggiero

08:30 – 09:10	Gas Desorption, Pressure Rise and other E-cloud Issues at PSR	Robert Macek	LANL
09:10 – 09:50	Heavy-Ion Induced Molecular Desorption: A Review of Three Years of Measurements at LINAC 3	Edgar Mahner	CERN
09:50 – 10:30	Ion Induced Desorption Yield Measurements at GSI	Andreas Kraemer	GSI
10:30 – 10:50	Coffee Break		
10:50 – 11:30	Issues in the Formation and Dissipation of the Electron Cloud	Miguel Furman	LBNL
11:30 – 12:10	PEP-II Vacuum Experience	Uli Wienands	SLAC
12:10 – 13:30	Lunch		

Afternoon Session - Chair: Robert Macek

13:30 – 14:00	Status and Upgrade of RHIC Beam Vacuum Systems	H.C. Hseuh	BNL
14:00 – 14:30	RHIC Pressure Rise Observation and Questions	SY Zhang	BNL
14:30 – 15:00	RHIC Electron Cloud and Vacuum Pressure Rise Characteristics	Ping He	BNL
15:00 – 15:30	Coffee Break		
15:30 – 16:00	GSI UHV System Upgrade	Hartmut Reich-Sprenger	GSI
16:00 – 16:30	Experiences at HERA with New Interaction Regions	Markus Hoffmann	DESY
16:30 – 17:00	Experimental Facilities at The Svedberg Laboratory, Uppsala	Lars Westerberg	Uppsala Univ.

Banquet

18:00 Berkner Hall – Room A

Thursday, December 11, 2003

Medical Building LCR, Building 490

Morning Session - Chair: Jie Wei

08:30 – 09:10	Beam Induced Pressure Rise Experienced in KEKB	Yusuke Suetsugu	KEK
09:10 – 09:50	Theory of Dynamic Vacuum Instability Induced by Lost Heavy Ions in the Accelerator Rings	Edil Mustafin	GSI
09:50 – 10:30	The Influence of Synchrotron Radiation on the VLHC Design	Peter Limon	FNAL
10:30 – 10:50	Coffee Break		
10:50 – 11:20	The CMEE Library for Modeling Electron Effects	Peter Stoltz	Tech-X
11:20 – 11:50	Outgassing Studies of Stainless Steel and Materials for a Detector System in the CELSIUS Storage Ring	Lars Westerberg	Uppsala Univ.
11:50 – 13:30	Lunch		

Afternoon Session - Chair: Arthur Molvik

13:30 – 14:00	Experience with NEG-Coated Vacuum Chambers at the ESRF	Roberto Kersevan	ESRF
14:00 – 14:30	Vacuum Pumping via Ti-V-Zr NEG Thin Films	Yulin Li	Cornell Univ.
14:30 – 15:00	Coffee Break		
15:00 – 17:00	Working group session		

Friday, December 12, 2003

Medical Building LCR, Building 490

Morning Session - Chair: Michel Chanel

08:30 – 09:00	Mechanism of Electron Multipacting with Long Proton Beam	Lanfa Wang	BNL
09:00 – 09:30	CESR-C Vacuum Performance	Yulin Li	Cornell Univ.
09:30 – 10:00	Proton Beam Scrubbing Study in RHIC	Haixin Huang	BNL
10:00 – 10:30	Coffee Break		
10:30 – 11:00	Diagnostics for E-p instability Observation	Vadim Dudnikov	BTG
11:00 – 11:30	Unexpected Beam Induced TE Waveguide Mode Modulation Effects in the SPS around 3 GHz	F. Caspers (F. Ruggiero)	CERN
11:30 – 12:00	OPEN		
12:00 – 13:30	Lunch		

Afternoon Session - Chair: Thomas Roser

13:30 – 14:00	Summary of Working Group 1 Electron and Ion Desorption	Edgar Mahner
14:00 – 14:30	Summary of Working Group 2 Chamber Coating and Treatment	H.C. Hseuh
14:30 – 15:00	Summary of Working Group 3 Electron Cloud Effect	Robert Macek

Adjourn

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ABSTRACTS

Tuesday, December 9, 2003

Tuesday Morning Session – Chair: Miguel Furman

1. Thomas Roser, BNL

09:10 - 9:40
RHIC Status and Plans

Three years after the start of operation the Relativistic Heavy Ion Collider (RHIC) has collided gold and polarized proton beams at close to design luminosity. In addition, the collider was also operated successfully with unequal species (deuteron on gold) for the first time. The performance and plans for future improvements and upgrades of the Relativistic Heavy Ion Collider will be reviewed.

2. Francesco Ruggiero, CERN

9:40 – 10:20
Electron Cloud Effects and LHC Concerns

I review electron cloud models, cures, and simulation results for SPS and LHC, compare them with measurements at the SPS, and discuss possible scenarios for the LHC.

3. Jie Wei, BNL

10:40 – 11:20
Beam loss and electron cloud in the SNS Ring: issues and remedies

Beam loss and electron-cloud effects limit the performance of a high-intensity accumulator like the Spallation Neutron Source Ring. The phenomena include beam-loss-induced radio-activation, loss-induced secondary electron emission, beam-induced electron multipacting, electron-proton instability, vacuum pressure rises, and interference with beam diagnostics. The ring design minimizes uncontrolled beam loss by using multistage collimation systems, adopting large transverse and longitudinal beam acceptances, and reserving long straight sections for improved injection flexibility and collimation efficiency. Electron-cloud effects are mitigated by surface treatment like chamber coating and beam scrubbing, stripped-electron collection, beam-in-gap clearing, and solenoid suppression and electrode clearing.

4. Wolfram Fischer, BNL

11:20 – 12:00
Beam Induced Pressure Rise in RHIC

When filling RHIC with intense ion beams, pressure rises are observed that are high enough to cause experimental backgrounds or even prevent machine operation. Currently this is one of the most severe limitations in the quest for higher luminosity. Pressure rises were observed with all ion species in RHIC: gold, protons and deuteron. While electron clouds were clearly established as a source of beam induced pressure rises, the role of ion and beam loss induced desorption is still under investigation. We summarize the observations, the effect of corrective actions taken and plans for further improvements.

Tuesday Afternoon Session – Chair: Katherine Harkay

5. Arthur W Molvik, LLNL

13:30 – 14:10
HIF (Heavy-Ion Fusion) Concerns

Accelerators for HIF have an economic incentive to fit beam tubes tightly to beams and to repetitively pulse at ~5Hz. This places them at risk from gas desorption runaway, and from electron clouds produced by secondary electrons and ionization of gas. We use a variety of charged particle diagnostics in quadrupole magnets and we measure the flux of electrons and gas ivolved from a target, near grazing incidence. We are adding electron modules to the WARP beam-dynamics PIC code, with the goal of a self-consistent, experimentally- validated tool for predicting electron effects in positive-beam accelerators.

6. Oliver Boine-Frankenheim, GSI

14:10 – 14:50
The International Accelerator Project at GSI

Heavy ion beam loss induced desorption is of major concern for the design of the proposed "International Accelerator Facility for Beams of Ions and Antiprotons" at GSI. The status of the R&D work and related accelerator experiments will be outlined.

7. Michel Chanel, CERN

14:50 – 15:30
LEIR: The Low Energy Ion Ring at CERN

Amongst all the modifications of the PS Complex to produce the LHC ion beams, the conversion of the old Low Energy Antiproton Ring (LEAR) into the Low Energy Ion Ring (LEIR) is a major issue. The accumulation in LEIR of 9*10^8 Lead ions in normalized transverse emittances of 0.7 um allows the production of 4 of the 592 bunches needed in one LHC ring, in one LEIR cycle. Then, it will take around 10 min to fill one LHC ring. The requested luminosity of 10^27 cm^-2s^-1 for lead ion collisions is reachable and is ~1000 times more that the actual chain (Linac3, PSB) can do. After a description of the whole chain, the production of Lead ion beams is described, with particular attention to the cooling, the injection system and the beam lifetime. Particularly, the results obtained during the first tests in 1997 will be described. The actions foreseen to decrease the outgassing of the vacuum chamber and the ions recombination with the electrons of the electron cooling will be outlined.

8. Jose Miguel Jimenez, CERN

15:50 – 16:30
Electron cloud induced pressure rises in the SPS

As the future injector of the LHC accelerator, the SPS is operated routinely with LHC-Type beams. Since August 98, its performances with LHC-Type beams have been limited by the electron cloud multipacting. This contribution will present the behavior of the pressures around the SPS ring in presence of the electron cloud multipacting phenomenon. The dependence of the pressure rises induced by the electron cloud on the beam parameters and the effect of a dipole field will be shown. The differences observed between the field free and the dipole field regions will be explained by the spatial and energy distributions of the electrons in the cloud and by the difference in the vacuum chamber heights. At room temperature, evidence of a vacuum scrubbing, beam conditioning and of the NEG coating as remedies to reduce the electron cloud activity will be shown. Preliminary results on the studies of the vacuum and electron cloud behavior at cryogenic temperature (30 K) will be presented. The effect of the surface coverage and the existence of the beam conditioning at cryogenic temperatures will be discussed.

9. SY Zhang, BNL

16:30 – 17:10
AGS Booster Issues

AGS Booster heavy ion program has longer than a decade history, and the Booster currently serves as the heavy ion injector to the RHIC. Beam intensity at the AGS-Booster complex has been limited at the Booster injection, and the beam loss is proportional to the intensity of the beam injected into the Booster. The transient pressure rise in several orders of magnitude at the beam injection was observed, and the beam lifetime due to capture loss derived from the pressure rise agree with the observation. Studies such as scraping beam at the injection septum to observe the septum voltage, scraping beam in the ring to observe the beam lifetime, using two injections to compare the beam lifetime, and using a Tandem setup to measure the beam scraping effect will be presented. Very large ion desorption rate at glancing angles, 1e5 to larger than 1e6 per incident Au32+ ions have been observed.

Wednesday, December 10, 2003

Wednesday Morning Session – Chair: Francesco Ruggiero

1. Robert J Macek, LANL

08:30 – 9:10
Gas desorption, pressure rise and other e-cloud issues at PSR

Gas desorption and other e-cloud effects, most notably the two-stream e-p instability have been studied extensively at PSR for the past several years. Much has been learned and the connection of the PSR observations and experience to gas desorption and pressure rise phenomena will be emphasized in this talk. While the e-cloud effects at PSR are now much better understood, a number of unresolved issues or puzzles remain and will also be reviewed. One such issue is the so-called first pulse instabilityin which the first beam pulse after beam has been off for several minutes is unstable (with all the characteristics of the e-p instability) while subsequent pulses a short time later

are stable. It disappears after a few weeks of beam operation, presumably due to beam scrubbing effects. Measures to control the e-p instability by partial suppression of the electron cloud formation such clearing fields, TiN coatings, and weak solenoids have been disappointing to date but could be the result of not suppressing electrons at all locations in the ring. One notable exception has been beam scrubbing, which has been the most effective measure to date. It presumably works on all the vacuum surfaces and reduces the electron cloud formation everywhere in the ring.

2. Edgar Mahner, CERN

09:10 – 9:50
Heavy-ion induced molecular desorption: a review of three years of measurements at LINAC 3

A dynamic pressure rise induced by the loss of heavy ions has been seen first in 1997 during Pb54+ accumulation and cooling tests in the Low Energy Antiproton Ring (LEAR) at CERN. Beam-induced desorption limited the beam lifetime and the intensity in LEAR. In preparation of the heavy ion physics with the LHC, LEAR has to be converted into a Low Energy Ion Ring (LEIR). An average dynamic pressure of 3 "e 10-12 Torr is required around the LEIR ring to satisfy the requested 30 s beam lifetime. To achieve this very low gas density in LEIR an intensive experimental programme has been launched at CERN in 2001 to measure the molecular desorption yields of lead ions at 4.2 MeV/u, to understand the limitations observed in 1997, and to prepare the LEIR vacuum system for heavy ion operation. Very large desorption yields of up to 2 "e 104 molecules/ion were measured for stainless steel vacuum chambers. The results obtained at LINAC3 are reviewed and their practical applications for the LEIR vacuum system are described.

3. Andreas Kraemer, GSI

09:50 – 10:30
Ion Induced Desorption Yield Measurements at GSI

In 2001 for the first time a vacuum pressure increase during a high intensity U28+ run in SIS-18 was observed. It was noticed that the lifetime of the ions was no longer independent of the injected ion current. During injection ions are lost at the chamber wall or other aperture limiting devices and desorb their gas molecules. This leads to a pressure increase and therefore to a higher charge exchange rate. Out of the data measured at SIS-18 it was possible to calculate the ion induced desorption yield to 10000-20000. Based on this experience and on measurements from CERN a dedicated experiment was set-up to measure ion induced desorption yields more systematically. First results of these experiments at HLI at GSI will be shown.

4. Miguel A Furman, LBNL

10:50 – 11:30
Issues in the formation and dissipation of the electron cloud

We present simulated and experimental results on the formation and dissipation of the electron cloud for intense proton beams. We focus, in particular, on the role played by the secondary electron yield and the secondary emission spectrum.

5. Uli Wienands, SLAC

11:30 – 12:10
PEP-II Vacuum Experience

Since early commisioning, multipactor effects have been seen in the PEP-II Low Energy positron Ring (LER). At high beam currents they can still be seen if conditions are suitable. Significant emittance growth, which manifested itself in the luminosity not scaling with the number of bunches in the rings, was also seen in the early experimental runs and attributed to the electron-cloud effect. Effective countermeasures have been solenoidal fields on the beam axis and the introduction of multiple “mini” gaps in the fill pattern, although the latter was temporarily abandoned when the available buckets filled up in the 6.3 ns bunch spacing in use until recently. The phenomenon was further studied using our bunch-by-bunch luminosity monitor as well as gated beam-size measurements, the latter indicating that indeed the first bunches in a mini train tend to be of smaller size. Recently we switched to 4.2 ns bunch spacing to increase the number of available buckets and reintroduced the mini gaps. While initially it seemed that emittance growth was stronger than in the 6.3 ns spacing, the issue is complicated by the presence of parasitic crossings due to the shorter spacing between bunches. In contrast, the High Energy electron Ring (HER) has not shown significant multipactoring effects (as expected). Ion trapping and fast-ion instability may be responsible for much-higher-than-expected transverse growth rates, however, the transverse bunch-by-bunch feedback system is able to control these at least at present beam currents. Episodes of suddenly elevated backgrounds which often require a beam dump to terminate them are seen and thought to arise from particulates trapped in the beam potential.

Wednesday Afternoon Session: Robert Macek

6. H.C. Hseuh, BNL

13:30 – 14:00
Status and Upgrade of RHIC Beam Vacuum Systems

RHIC consists of two interweaving rings with circumference of 3.8 km. The total length of warm beam vacuum is ~1.2 km, consisting of the 54 insertion regions and beam interaction regions. Most warm sections are pumped by ion pumps and titanium sublimation pumps. The average pressures of the warm sections have reached below 1e-10 Torr, owing to the gradual bakeouts of these sections over the last three years. With increasing Au beam intensity, rapid pressure rises of several decades were observed at warm sections. To understand and combat the pressure rise, electron detectors, axial-field solenoids and fast data logging have been implemented. NEG coated beam pipes have been installed. The effectiveness of these measures will be summarized.

7. SY Zhang, BNL

14:00 – 14:30
RHIC Pressure Rise Observation and Questions

Two type of pressure rises have been observed in past two runs in the RHIC, which are the electron cloud induced pressure rise at the injection, and the beam transition pressure rise for ions. Both are currently limiting the RHIC beam intensity. The RHIC electron cloud has distinguished characteristics from other machines, which is that the electron multipacting may occur for up to 216 ns bunch spacing, and it depends on the locations in the ring. The transition pressure rise is closely related with the beam momentum spread, and it is proportional to the total beam intensity. In this talk, observations in the RHIC pressure rise indicating a possible scenario of the beam halo scraping effect will be presented. Several possible counter measures in this direction will be discussed.

8. Ping He, BNL

14:30 – 15:00
RHIC electron cloud and vacuum pressure rise characteristics

By the reviewing the beam experiment data of RHIC pressure rise during 2003 run, the residual gas composition during multipacting and its evolution along the pressure rise will be presented and discussed, it is very helpful toward our understanding in this critical issue. Some simulation results of the solenoid effect for reducing the electron cloud also be reported.

9. Hartmut Reich-Sprenger, GSI

15:30 – 16:00
GSI UHV system upgrade

Pressure rises observed during high current operation of the SIS18 at GSI make it necessary to start an UHV upgrade program. The strategy of this program will be discussed.

10. Markus Hoffmann, DESY

16:00 16:30
Experiences at HERA with new Interaction Regions

Since 2002 the HERA ep collider is operated with completely new designed interaction regions that allow to focus both beams to smaller cross-sections at the IP's, resulting in an increase of the luminosity by a factor 3. A major part of this improvement is achieved by positioning the focusing quadrupoles closer to the IP. In particular Superconducting combined function magnets are installed inside the experimental detectors at a distance of only 2m from the IP. The dynamic behavior of the vacuum in the IR is complicated due to the combination of warm and cold surfaces as well as the dependence of the p-gas induced background on electron beam induced photo desorption and HOM heating.

11. Lars A Westerberg, Uppsala University, The Svedberg Laboratory

16:30 – 17:00
Experimental facilities at The Svedberg Laboratory, Uppsala

The Svedberg Laboratory cyclotron can deliver the following beams: protons up to 1 MeV and light heavy ions (alpha, B, C, N, O) to 45 MeV/u, Ne to 40 MeV/u, etc up to 129Xe29+ at 9.6 MeV/u. A 20 m long beam line in the Gamma Cave could be used for beam induced pressure studies. In the CELSIUS storage ring protons are accelerated to 1.36 GeV, and light heavy ions to 0.47 GeV.

Thursday, December 11, 2003

Thursday Morning Session – Chair: Jie Wei

1. Yusuke Suetsugu, KEK

08:30 – 9:10
Beam Induced Pressure Rise Experenced in KEKB

KEK B-factory (KEKB) is an electron-positron collider with asymmetric energies to quest CP violation in B quark decay. We had observed several phenomena accompanying a pressure rise during commissioning especially in the positron ring. First example is the pressure rise non-proportional to the stored beam current. That has been understood as due to a multipactoring of electrons, which is deeply related to photoelectron instability in a positron ring. Second one is that by heating of pump element due to Higher Order Mode (HOM). HOM dampers and RF-shield gaskets relieved the pressure rise. We will report about these experiences in KEKB.

2. Edil Mustafin, GSI

09:10 – 9:50
Theory of dynamic vacuum instability induced by lost heavy ions in the accelerator rings

The theory describing self-consistent vacuum pressure profile in the heavy ion accelerators with account of beam loss induced gas desorption is presented. Verifications of some theoretical results with the measurements and their applications to the high intensity accelerator vacuum system design are discussed.

3. Peter Limon, FNAL

09:50 – 10:30
The Influence of Synchrotron Radiation on the VLHC Design

Ultra-high-energy hadron colliders emit significant synchrotron radiation power in a cryogenic environment. Handling this power influences design parameters such as optimum magnetic field, radius of curvature and beam-tube diameter. We will show that the optimum magnetic field for a VLHC is not as high as could be attained, but is more likely to be in the range of 10 T to 12 T, resulting in a very large circumference ring. We will also present some designs and first models for intercepting synchrotron radiation at higher emperature, resulting in a more efficient cryogenic design and higher luminosity.

4. Peter B Stoltz, Tech-X Corporation

10:50 – 11:20
The CMEE library for modeling electron effects

The CMEE library is a collection of routines for numerically modeling electron effects. CMEE stands for Computational Modules for Electron Effects. These routines will allow users to model secondary electron emission and neutral gas ionization, among other things. The secondary electron emission routines are based on the routines from the POSINST code from Miguel Furmans group at Lawrence Berkeley National Labs. The first release of CMEE is now available. I will discuss how these routines can be used within any code and how we applied them to study electron effects in the High Current Experiment.

5. Lars A Westerberg, Uppsala University, The Svedberg Laboratory

11:20 – 11:50
Outgassing studies of stainless steel and materials for a detector system in the CELSIUS storage ring

We have, in collaboration with the CERN vacuum group, studied outgassing from air baked and vacuum fired stainless steel and correlated this with bulk hydrogen concentrations. To construct the CHICSi detector system with 2000 silicon and scintillation detectors for high-energy heavy-ion reaction studies, placed at a cluster-jet target in the UHV system, we have measured outgassing from different types of cables, insulators, printed circuit boards and two-component epoxies.

Thursday Afternoon Session – Chair: Arthur Molvik

6. Roberto Kersevan, ESRF

13:30 – 14:00
Experience with NEG-Coated Vacuum Chambers at the ESRF

The ESRF has been the first synchrotron radiation light source to have installed several NEG-coated, narrow-gap vacuum chambers, up to 5 meters in length. In-air insertion devices (IDs) require narrow-gap vacuum chambers, as the gap between their magnetic elements can nowadays be as small as 10 mm. In addition to the small gap, the ID elements leave no space for the installation of vacuum pumps, thus creating a rather large pressure bump. This pressure bump interacts with

the 6 GeV electron beam, generating high-energy bremsstrahlung radiation (BS). The main motivation for using such technology has been the necessity to reduce the BS radiation level inside the experimental hutches of the beamlines. Vacuum chamber materials are copper coated stainless steel and extruded aluminum. A total of 54.4 meters of narrow gap chambers are presently installed in the 845 m long, 6 GeV storage ring. Vacuum conditioning curves will be shown, and relevant machine physics issues will be discussed.

7. Yulin Li, Wilson Synchrotron Lab

14:00 – 14:30
Vacuum Pumping via Ti-V-Zr NEG Thin Films

Achieving and maintaining extreme high vacuum (XHV) ($P<10^{-12}$ torr) are essential to the success of the high current DC photo-electron source for the proposed Cornell Energy Recovery Linac (ERL). Vacuum pumping via non-evaporable getter (NEG) thin film deposited directly onto the interior of a vacuum chamber is a promising route to XHV. 'Engineering' studies were carried out to evaluate the pumping performance of the Titanium-Zirconium-Vanadium (TiZrV) NEG thin films. The compositions and the growth rates of the NEG thin films, deposited on stainless steel tubes using DC Magnetron sputtering, were investigated using Rutherfield Backscattering Spectrometry. The pumping speeds and capacities of the thin films were measured as functions of activation temperatures and durations, and film thickness for two representative gases, CO and H_2. Though pumping of CO and H_2 by the NEG films is observed with activation temperature as low as 150°C, the pumping performance of the NEG films improve significantly with activation temperatures above 300°C. Tests also indicated that excessive sorption of hydrogen may damage mechanic property of the NEG thin films.

15:00 – 17:00
Working Group Session

Friday, December 12, 2003

Friday Morning Session – Chair: Michel Chanel

1. Lanfa Wang, BNL

08:30 – 09:00
Mechanism Of Electron Multipacting With Long Proton Beam

The electron motion under electric and magnetic fields is studied. The mechanism of "trailing edge multipactor" and electron trapping has been analyzed. Various factors related to the electron multipacting have been investigated by numerical method and compared with analytic and experimental results.

2. Yulin Li, Wilson Synchrotron Lab

09:00 – 09:30
CESR-C Vacuum Performance

The e+e- collider CESR is expanding its beam energy reach to below 2 GeV for the planned Charm Physics program while maintaining high energy (~5 GeV) operations for the dedicate CHESS runs. During the CESR-c operations, the distributed ion pumps in the arcs of CESR are no longer functioning due to the reduced dipole magnetic field at the lower beam energy. However, it is observed that the well conditioned vacuum chamber walls act as getters and provide sufficient pumping to ensure good beam lifetime for the CESR-c operations. We present in this report the vacuum operational experiences on the beam conditioning and on the 'wall-pumping' activation.

3. Haixin Huang, BNL

09:30 – 10:00
Proton Beam Scrubbing Study in RHIC

One intenisty limiting factor in RHIC opeartion is the electron cloud induced pressure rise. A beam scrubbing test was recently performed in RHIC. The results show that with some time of scrubbing with high intensity 112-bunch proton beam, the pressure rise can be reduced to allow higher bunch intnesity operation.

4. Vadim Dudnikov, Brookhaven Technology Group, Inc.

10:30 – 11:00
Diagnostics for e-p instability observation

Diagnostics for observation and identification of instabilities driving by interaction with secondary plasma are considered. Clearing electrodes, fast extractors, repulsing electrodes, electron and ion collectors with retarding grids, particles spectrometers using for detection of secondary particles generation and secondary particles identification will be discussed. Features of electrostatic and magnetic dipole and quadrupole pickups will be presented. An influence of nonlinear generation of secondary plasma in driving and stabilization of e-p instability is discussed.

Observations of anomaly in secondary particles generation will be presented

5. **F. Caspers (Presented by F. Ruggiero), CERN**

11:30 – 12:00

Unexpected Beam Induced TE Waveguide Mode Modulation Effects in the SPS around 3 GHz CERN

In order to measure the beam induced electron cloud density using low power microwaves a section of about 30 meter length of the CERN SPS (Super Proton Sychroton) has been equipped with suitable mode launchers for microwave mode transmission through the beampipe. According to theoretical expectations the electron cloud should have produced a phase modulation of a few degrees similar as found in the ionosphere on GPS (global positioning system) signals and for comparable electron densities. Instead a very strong amplitude modulation has been seen with beam present, but a direct modulation from the circulating highly relativistic protons can be excluded for several reasons. The setup is presented, measured data are shown and an attempt for explanation of the results is discussed.

Friday Afternoon Session – Chair: Thomas Roser

13:30 – 14:00

Summary of Working Group 1

Electron and Ion Desorption **Edgar Mahner**

14:00 – 14:30

Summary of Working Group 2

Chamber Coating and Treatment **H. C. Hseuh**

14:30 – 15:00

Summary of Working Group 3

Electron Cloud Effect **Robert Macek**

ADJOURN

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Beam Induced Pressure Rise in Rings

Brookhaven National Laboratory, Upton, NY

December 9 - 12, 2003

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